the metal, there remained only a solution of Fe_2Cl_3, in which the magnetised bar A gradually assumed its normal electro-positive position; this reaction is exemplified by the results in Table C, Col. 4, Division II. The comparative non-activity of HCl on magnetised bars is very singular, and at present unaccountable. In conclusion, I may state that this research has shown that a current flows from a magnetised bar towards an unmagnetised one, when the two are immersed in suitable solutions, and that the result was dependent both on the nature and strength of the solution, and also on the extent of the magnetisation of the metal. It has also been demonstrated that when a magnetised rod constitutes one element in a suitable electrolyte acting upon it, local currents flow from the more highly magnetised polar terminals towards the less magnetised or neutral equatorial portions. These conditions would cause the magnetised rod to be more generally acted upon by the electrolyte, the composition of the solution surrounding it being thereby also affected, and to a considerable extent this might account for its electro-positive position compared with the unmagnetised rod, otherwise under the same conditions. Observations have also been made on the influence of magnetisation in relation to the passive state of iron in nitric acid, with interesting results. In the present state of the inquiry it is preferable to confine oneself to a simple record of facts; I think, however, it has been clearly demonstrated in course of the numerous and varied experiments of this research, that the magnetisation of iron and steel influences the action of reagents upon the metal.

V. "Report on the Capacities, in respect of Light and Photographic Action, of two Silver on Glass Mirrors of different Focal Lengths." By the Rev. C. PRITCHARD, D.D., F.R.S., Savilian Professor of Astronomy, Oxford. Received April 18, 1888.

In May of last year, I was requested by a Committee on stellar photography, appointed by the Council of the Royal Society, to examine the comparative photographic capacities of two silver on glass mirrors, each having an aperture of 15 inches, but of different focal lengths, viz., 80 inches and 120 inches respectively. In the present report these will be designated by the symbols $\frac{15}{80}$-inch and $\frac{15}{120}$-inch. The mirrors in question were provided by the generosity of Dr. Warren de la Rue. Various unforeseen difficulties incidental to pioneering in a science still in its infancy have intervened, unavoidably impeding the progress of the enquiry. The chief among these have been:—1. The comparatively imperfect automatic mechanism of the driving apparatus attached to the telescope carrying the

mirrors; 2. The difficulty of adjusting the camera or plate holder perpendicularly to the axis of the mirror, on a temporary mounting, and distant from the workshop of the optician; 3. An abnormal sky which has continually perplexed astronomers during many months.

It must not be overlooked, that even the considerable precision, necessary or desirable in the clock motion of a telescope used for micrometrical measures, is comparatively useless for astronomical photography; for in this latter case the momentary swerving of the telescope through even a second or two of arc, may be fatal to the circular form of the star images impressed on the plate; and, moreover, it is necessary to maintain this accuracy of steady motion, not merely for a very few minutes at a time, but occasionally for half an hour, or a full hour, or even more. It is true that resort may be had, and in fact must always be had, to the old method of supplementing the driving machine by the occasional assistance of eye and hand; but unless that machinery is approximately perfect, the strain upon the observer's attention becomes practically insupportable. This perfect steadiness of motion is also necessary from another point of view, because in its absence, it will not be easy to distinguish between the effects of unsteady motion and any optical defect of the mirror. Happily these difficulties have been at length overcome; and in the month of January last, by the aid of an improved screw, worked on a new engine by Sir H. Grubb, and a subsidiary electrical control connecting the driving apparatus with a seconds pendulum, I had the pleasant satisfaction of hearing from Mr. Jenkins, the assistant chiefly engaged in the present operation, that he now felt no severe strain or stress of attention in watching and occasionally aiding the motion, during the space of an hour or more on the rare occasions when the variability of the sky permitted such long exposures. I am not here speaking of my own experience alone, but I have reason to know that the same troubles have been shared to a greater or less extent by all the few eminent observers who are in this country employed in a similar pursuit. A modification of the ingenious contrivance by which the desired effects have been produced has been recently exhibited by Sir H. Grubb at the Royal Astronomical Society and at the Society of Arts in London.

The mirrors referred to above, were mounted in succession on the tube of the large equatorial in the Oxford University Observatory, and they proved to be of that excellent optical quality which might be expected in Mr. With's best performance.

The points to which I chiefly directed my attention in the examination of these mirrors were as follows:—

I. The general character of the stellar images impressed by the two mirrors, absolute and comparative.

II. The relative amounts of light reflected by each.
III. Their relative capacities in respect of distortion in the figure of the stellar images, and the optical distortion of the field.
IV. Their photographic capacity in respect of the faintest stars impressed on plates, with exposures of given duration.

I. *The General Character of the Stellar Images impressed.*

It was originally proposed to employ the same sized plate, viz., 4 inches square, for both mirrors, and thus in the $\frac{15}{80}$-inch mirror have the opportunity of examining a field of about nine square degrees; but it was found impossible, inasmuch as the images, even towards the centre of the plate, were found to be impressed with a white centre. To a certain extent, these malformations were predicted in a paper by General Tennant in the 'Monthly Notices of the Royal Astronomical Society.'

This phenomenon necessitated the abandonment of so large a plate with its circular carrier of seven and a half inches diameter, for a smaller plate and smaller carrier having an angular field of 1° 56′ or nearly four square degrees. With this plate the images became round in the centre, and continued so to a distance of about 40′ from the centre. Then they became decidedly elliptical, having their extremities remote from the centre fainter than the opposite extremities. At the edge of the plate, the figure of the star on the side remote from the centre appeared to be not closed at all, but presented the appearance of a fan. I have, however, not observed the focal lines at right angles to each other, as seen and described by the Astronomer Royal. In the $\frac{15}{120}$-inch mirror and 4-inch plate, which presents also a field of nearly four square degrees, the phenomena here described are generally very much less pronounced, and commence at a greater distance from the centre.

The conclusions which I feel disposed to draw from the foregoing remarks, are the general unsuitability of mirrors of short focal length, and the impossibility of obtaining a large angular field in such mirrors, of a character serviceable for charting the heavens by means of photography. How far this difficulty may be obviated in refractors suitably corrected, and of comparatively short focal length, it is beyond my experience to indicate. Before instituting this trial, I had some hope, that with so simple an optical appliance as a mirror, a much larger available field might have been practically secured than has proved to be the case. I apprehend, however, that in point of light, that is, having regard alone to the faintness of the stars which, *cœteris paribus*, can be photographed, the advantage is practically on the side of the reflector.

Another point of some importance in the character of the images

impressed by these mirrors is the tendency of those formed from bright stars, to spread themselves over a larger portion of the film in the short focus mirror, and consequently to increase the difficulty of bisection. In the smaller stars, this peculiarity is not so apparent. I am here, contrary to my wont, unable to appeal to numerical data, so essentially necessary in discussions of this description, and where mere estimates and impressions are apt to mislead the judgment. The impossibility of procuring photographs of the same star from the two mirrors under exactly similar circumstances, and therefore of eliminating the relative amount of sensitiveness of the plates employed, the character of the night, and many other circumstances which occur in stellar photography, render the test of numbers impracticable. I state here the experience gained from the examination of many photographs; and in immediate connexion with this point of experience, I may mention that the conclusion has been forced upon me, that the images formed from a de la Rue metallic mirror are harder and less extended than those formed from equal exposures on a silver on glass mirror. If I were to hazard an opinion, expressed not without reserve, I should say that the difference between the action of a metallic mirror and a silver on glass mirror, may not unfitly be compared to the difference between the action of a metallic mirror, and the action of such photographic object-glasses as have come under my own observation.

II. *The Relative Luminosity of the Images of Stars, formed by the Two Mirrors.*

The mirrors were originally silvered by Mr. Browning, about March 19th, 1887. They were in constant use until January 26th, 1888, and on that date the $\frac{15}{120}$-inch mirror was examined as to its light-reflecting capacity. The secondary plane reflector was silver on glass. The method of determination was the comparison of the places of extinction in the wedge photometer of three stars viewed respectively in the $\frac{15}{120}$-inch mirror, in the $12\frac{1}{4}$-inch Grubb refractor, and in the 4-inch finder attached to the latter. Each star was extinguished five times in each observation. The method of computation adopted in the light comparison was that explained in the 'Memoirs of the Royal Astronomical Society,' vol. 47.

The results are as follows:—

$$\text{I.}\quad \frac{\text{Light reflected by } \frac{15}{120}\text{-inch mirror}}{\text{Light transmitted by } 12\frac{1}{4}\text{-inch refractor}} = 1{\cdot}18.$$

$$\text{II.}\quad \frac{\text{Light reflected by } \frac{15}{120}\text{-inch mirror}}{\text{Light transmitted by 4-inch refractor}} = 9{\cdot}15.$$

This mirror was subsequently re-silvered at the Observatory by Mr. Jenkins, the film deposited being excellent, February 6th, 1888,

and the light was re-determined by the same method, and the same stars, on March 3rd, 1888, the weather admitting of no earlier trial. Result:—

$$\text{III.}\quad \frac{\text{Light reflected by } \frac{15}{120}\text{-inch mirror}}{\text{Light transmitted by } 12\frac{1}{4}\text{-inch refractor}} = 1{\cdot}20.$$

$$\text{IV.}\quad \frac{\text{Light reflected by } \frac{15}{120}\text{-inch mirror}}{\text{Light transmitted by 4-inch refractor}} = 9{\cdot}72.$$

The $\frac{15}{80}$-inch Mirror.

Determination by the process explained above, on January 3rd, 1888, of the light reflected by the $\frac{15}{80}$-inch mirror. Result:—

$$\text{V.}\quad \frac{\text{Light reflected by the } \frac{15}{80}\text{-inch mirror}}{\text{Light transmitted by the } 12\frac{1}{4}\text{-inch refractor}} = 1{\cdot}23.$$

$$\text{VI.}\quad \frac{\text{Light reflected by the } \frac{15}{80}\text{-inch mirror}}{\text{Light transmitted by the 4-inch refractor}} = 10.$$

This mirror was re-silvered at the Observatory by Mr. Jenkins on January 9th, 1888, and re-examined on January 17th, 1888. With the results—

$$\text{VII.}\quad \frac{\text{Light reflected by } \frac{15}{80}\text{-inch mirror}}{\text{Light transmitted by } 12\frac{1}{4}\text{-inch refractor}} = 1{\cdot}33.$$

$$\text{VIII.}\quad \frac{\text{Light reflected by } \frac{15}{80}\text{-inch mirror}}{\text{Light transmitted by 4-inch refractor}} = 10{\cdot}70.$$

On combining the above results, it appears that by means of the comparisons with the $12\frac{1}{4}$-inch refractor—

$$\text{IX.}\quad \frac{\text{Light of } \frac{15}{80}\text{-inch mirror re-silvered}}{\text{Light of } \frac{15}{80}\text{-inch mirror after 9 months' use}} = \frac{1{\cdot}33}{1{\cdot}23} = 1{\cdot}08,$$

and from comparison made with the 4-inch refractor—

$$\text{X.}\quad \frac{\text{Light of } \frac{15}{80}\text{-inch re-silvered}}{\text{Light of } \frac{15}{80}\text{-inch mirror after 9 months' use}} = \frac{10{\cdot}7}{10} = 1{\cdot}07.$$

In like manner, from similar processes with respect to the $\frac{15}{120}$-inch mirror, it appears that when the comparisons were made by the aid of the $12\frac{1}{4}$-inch refractor—

$$\text{XI.}\quad \frac{\text{Light of } \frac{15}{120}\text{-inch mirror re-silvered}}{\text{Light of } \frac{15}{120}\text{-inch mirror after 9 months' use}} = \frac{120}{118} = 1{\cdot}01,$$

and when compared by means of the 4-inch refractor—

$$\text{XII.}\quad \frac{\text{Light of } \frac{15}{120}\text{-inch mirror re-silvered}}{\text{Light of } \frac{15}{120}\text{-inch mirror after 9 months' use}} = \frac{9{\cdot}72}{9{\cdot}15} = 1{\cdot}06.$$

The approximate identity of the above results is, I think, such as to commend the method adopted with the wedge photometer to con-

fidence, inasmuch as these small discrepancies are well within the limits of the errors of observation.

The conclusions to be drawn from these results thus obtained are: 1. The very slight deterioration of the mirrors after nine months' constant use and exposure. 2. The very considerable amount of light reflected by these mirrors when compared with that transmitted by the Grubb object-glass, amounting in fact to this, that a mirror of 15 inches aperture affords an image of a star as brilliant as that formed by an object-glass (of the particular quality presented) of 13·35 inches aperture. 3. A slightly increased, but only a slightly increased, luminosity of image is caused by the adoption of the focal length of 80 inches instead of 120. The result, referred to above in 2, is in conformity with the remark made by Dr. Robinson, in 'Phil. Trans.,' vol. 151, to the effect that in respect of the luminosity of the image, Newtonian reflecting telescopes of attainable aperture would probably surpass refractors of attainable dimensions, on account of the increasing absorption of light, by reason of thickness, unless indeed the translucency of glass can be sensibly improved.

It is to be noticed that with an exposure of half an hour in the $\frac{15}{80}$-inch mirror, the existence of nebulosity in the neighbourhood of Maia is distinctly traceable on the photographic plate. With the exposure of an hour it is observable in form. No trace of the fainter nebulosity near Merope has been impressed.

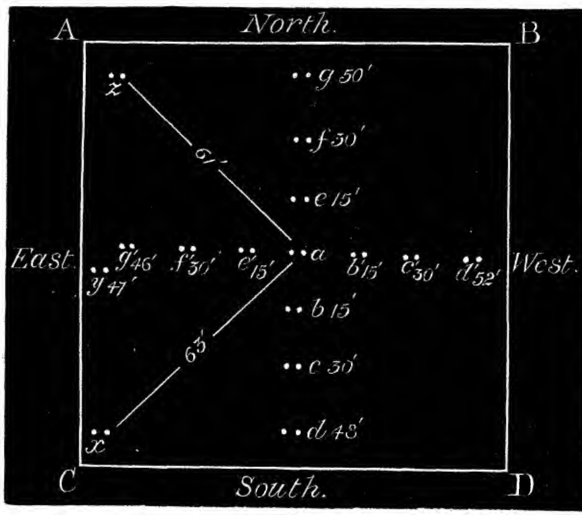
III. *The Angular Extent of Apparently Undistorted Field, and the Amount of Distortion where it Exists.*

The determination of these elements is of the utmost importance in the formation of charts of the heavens by the aid of photography, inasmuch as on the superficial extent of the reliability of the photographic field depend the time, labour, and cost of charting the heavens. A general idea of this extent of reliable field may be gathered from the quality of the stellar images impressed at different distances from the centre of the plate. Thus in the case of the $\frac{15}{80}$-inch mirror at about forty minutes from the centre of the plate the star images cease to be sufficiently circular, although for a short distance beyond, distances between these stellar disks may still be measured, though not possessing the utmost reliability. In the case of the $\frac{15}{120}$-inch mirror, this angular extent of measurable field extends beyond fifty-one minutes from the centre. This very perceptible superiority of the $\frac{15}{120}$-inch mirror arises, partly, no doubt, from its longer focus, and it may also be influenced by the effects of the intervention of the plate holder; but be the causes what they may, the superiority longer focus is unquestionable in respect of extent of field.

But an equally important element remains to be investigated, namely, the amount of distortion which exists at different distances

from the centre of the plate, and in order to ascertain this, I made a preliminary examination of the optical quality of the field, by the method which I have described in vol. 47 of the 'Memoirs of the Royal Astronomical Society' (p. 238). This method consists in shifting the images of the same pair of stars to widely different localities in the field of view, and it was argued that so long as the measured angular distances between these pairs remained sensibly the same, *i.e.*, within the known and unavoidable limits of observational error, so long might the optical field of view be relied upon as sensibly accurate.

FIG. 1.



ABCD represents the photographic plate where AB is 4 inches, and subtends an angle of 1° 55′ at the centre of the $\frac{15}{120}$-inch mirror. A pair of stars of approximately the seventh magnitude was selected, and photographed near the centre of the plate, as at (a), with an exposure of five minutes. The telescope was then moved approximately fifteen minutes to the south, and a second photograph taken, by which this same pair was removed to (b). This process was repeated again and again in northerly, easterly, and westerly directions, till after thirteen exposures this same pair of stars was dotted about the plate as in the diagram. This same process was repeated on three plates on the same night (March 3, 1888). The distances between each pair were then measured, and the means of five measures of each pair were taken as the adopted measures for each pair respectively. The results are as follows:—

Distances between the Pair of Stars, corrected for Refraction.

Position of star..	*a.*	*b.*	*c.*	*d.*	*e.*	*f.*	*g.*
Plate I..	152″·00	151″·92	151″·93	151″·99	152″·07	152″·22	152″·02
II..	151·88	2·07	1·81	152·10	1·88	1·95	2·02
III..	152·08	2·17	2·05	2·03	1·96	2·07	2·44
Mean...	151·99	152·05	151·93	152·04	151·97	152·08	152·16
Position of star..	*a.*	*b′.*	*c′.*	*d′.*	*e′.*	*f′.*	*g′.*
Plate I..	152″·00	152″·14	152″·05	152″·17	151″·89	151″·91	152″·05
II..	151·88	2·19	2·08	2·36	1·83	1·96	1·86
III..	152·08	2·07	2·00	2·24	2·05	1·76	2·10
Mean...	151·99	152·13	152·04	152·26	151·92	151·88	152·00

The following table exhibits the deviations of the intervals from the central interval at different positions on the plate:—

Due North	15′	−0″·02
	30	+0·09
	50	+0·17
Due South	15	+0·06
	30	−0·06
	48	+0·05
Due East	15	−0·07
	30	−0·11
	46	+0·01
Due West	15	+0·14
	30	+0·05
	52	+0·27

When it is remembered that the unavoidable error of such measures is about 0″·2 (where 0·0001 in. is equivalent to 0″·17), the only conclusion to be drawn is that to the extent of the field impressed on this plate of 1° 55′ square, there is no perceptible or measurable distortion in the apparent distance of these pairs, and in fact that small measured distances may be relied upon throughout the field; and thus, if a few stars are scattered about the plate with known co-ordinates, those of all the rest may be conveniently determined with great accuracy.

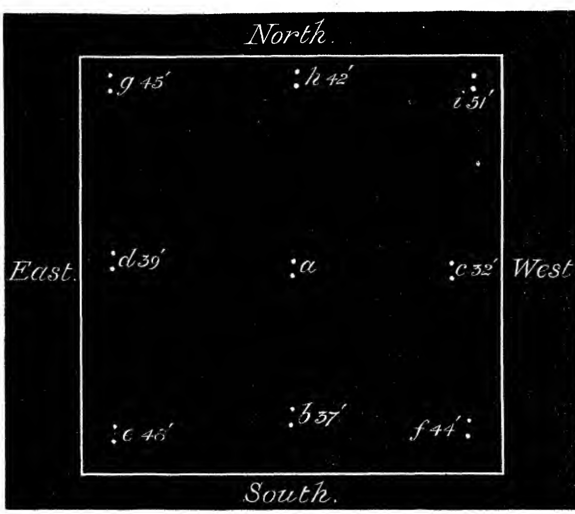
Subsequently to the above operation it was thought well to examine a pair of stars on the same plates, which happened to fall near the angles, viz., at (x) and (z), impressions of the same pair as those at y. The distance of (x) and (z) from the centre of the plate was approximately 63′, but it must be added that the impressed disks were slightly elliptical. The resulting distances between the stars of these three pairs were as follows:—

	x.	y.	z.
Plate I	176″·53	176″·11	176″·35
II	6·17	6·10	176·29
III	6·22	6·64	176·15

Examination of the Field of the $\frac{15}{80}$-inch Mirror.

The photographic plate here is nearly 3 inches square, subtending an angle of 1° 56′. The pair of stars selected consisted of Atlas and Pleione, and these by the motion of the telescope were made to occupy successively the positions indicated in the subjoined diagram, which will be understood from the description of the former. The tables are arranged on the same plan.

FIG. 2.



Distances of Atlas from Pleione, corrected for Refraction.

Position of star....	*a.*	*b.*	*c.*	*d.*	*e.*
Plate I	301″·21	301″·47	301″·52	301″·29	301″·63
II	1·15	1·53	1·74	1·53	1·80
III	1·40	1·32	1·60	1·47	1·52
Mean........	301·25	301·44	301·62	301·43	301·65

Position of star....	*f.*	*g.*	*h.*	*i.*	
Plate I	301″·37	301″·32	301″·58	302″·17	
II	1·41	1·60	1·79	2·01	
III	1·29	1·39	1·71	1·92	
Mean........	301·36	301·44	301·69	302·03	

The following table exhibits the deviations of the intervals from the central interval at different positions on the plate:—

Due North	42′	+0″·44
N. West	51	+0·78
Due West	32	+0·37
S. West	44	+0·11
Due South	37	+0·19
S. East	48	+0·40
Due East	39	+0·18
N. East	45	+0·19

It should be observed here, that while the linear discrepancies of measured distances are the same as those with the $\frac{15}{120}$-inch mirror, they indicate larger angular discrepancies in the ratio of 3 : 2. Nevertheless, the examination of these angular discrepancies exhibits evident traces of distortion, sufficient to render extreme accuracy of measures unattainable without the great difficulty of an extensive tabulation; in other words, the comparative short focus of this mirror is not well adapted to the purposes of accurate measurement. Perhaps I ought here to refer to the very careful examination of the field of the Grubb refractor of 12¼ inches aperture and 176 inches focal length, recorded in the 'Memoirs of the Royal Astronomical Society,' vol. 47, p. 238, in which it appears that no absolute reliance could be assigned to measures extending beyond 12 minutes from the

centre of the field, that is to say, beyond a field whose diameter exceeds 1400″.

Over and above this question of the accurate measurement of small distances from stars of known co-ordinates scattered about the field, there is the question of the possibility of accurate measurement of considerable distances from the centre of the plate itself. In other words, can a linear measure on a photographic plate be accurately translated into the corresponding angular distance between two stars by simple multiplication by a constant? In order to investigate this very important question, I had a series of measures made of sixteen stars of the Pleiades from the star (p) Pleiadum, compared with the corresponding heliometer measures, as given by Dr. Elkin in the Yale College publications. These distances extend from 400″ to 3200″. The form which this examination assumed was that proposed by Dr. Gill in the 'Bulletin du Comité International Permanent pour l'Exécution Photographique de la Carte du Ciel,' Paris, 1888, in which the heliometer distance (s) between two given stars is equated to—

$$as + bs^2 + cs^3 + \&c.,$$

where (s) is the distance, measured on the plate in *inches*. This investigation was first applied to the shorter focus mirror, inasmuch as it was expected to indicate sensible discrepancies from an uniform scale. The solution of the equations of condition give the following form for the conversion of the linear distance (s) into angular measure:—

$$2577''{\cdot}0396\, s + 0''{\cdot}4546\, s^2.$$

The probable error of the coefficient of s^2 is $\pm\ 0''{\cdot}2831$, indicating an amount of insecurity which renders this method of investigation somewhat doubtful; but taking it as it stands, this formula shows that while in a measured distance of half an inch, equivalent to 1200″, no measurable error beyond $0''{\cdot}1$ is introduced, yet in a measure of 2 inches from the centre there is a possible or even probable correction to be made, amounting to nearly two seconds. This seems to indicate the absolute necessity of a rigid investigation of the photographic field of all instruments in which that field is extensive.

A similar enquiry, referred also to Dr. Elkin's heliometer measures, was made though on a more restricted field, in the case of the de la Rue mirror, which has already been so extensively used for exact astronomy. In this case the coefficient (b) of the term depending on the square of the linear distance (s) inches, is

$$+\ 0''{\cdot}333 \pm 0''{\cdot}202,$$

and, inasmuch as the measures actually made use of hitherto have never exceeded 0·75 inch from the centre of the field, this correction (admitting its reality) indicates an uncertainty of about $0''\cdot16$. In the method employed for parallax determinations with this instrument, this source of error, small as it is, is effectually eliminated by the avoidance of all but differential measures.

IV. *The Photographic Capacities of the Two Mirrors in respect of the Faintest Stars impressed on Plates with Exposures of given Duration.*

The method employed was that described in the 'Proceedings of the Royal Society,' No. 247 (read May, 1886). It consisted in taking with each of the two mirrors three plates of the Pleiades exposed for 5, 30, and 60 minutes respectively. The diameters of a few stars whose magnitude had been well determined by the wedge photometer were measured five times on each of the plates, and then by the means indicated in the above-mentioned paper, the following results were obtained:—

Mirror $\frac{15}{120}$-inch.

Exposures of 5, 30, and 60 minutes, respectively, gave—

5 min. :—log mag. required = log 11·14 (mag.) − 0·0204 δ.
30 min. :—log mag. required = log 13·55 (mag.) − 0·0203 δ.
60 min. :—log mag. required = log 14·79 (mag.) − 0·0193 δ.

In the above formula log 14·79 indicates the magnitude of the faintest star just beginning to be impressed on the photographic plate during its exposure of 60 minutes. This number and the coefficient of δ were obtained in the manner already referred to above, where δ is the measured diameter of the star whose magnitude is sought, expressed in seconds of arc.

In like manner, the magnitude of the faintest star, during an exposure of 30 minutes, was 13·55 magnitude, and during an exposure of 5 minutes, was 11·14 magnitude.

Mirror $\frac{15}{80}$-inch.

A similar investigation applied to this mirror gave the following results after exposures of similar duration:—

5 min. :—log mag. required = log 11·93 − 0·0215 δ.
30 min. :—log mag. required = log 13·79 − 0·0186 δ.
60 min. :—log mag. required = log 15·13 − 0·0197 δ.

From this it appears that the photographic capacity in respect of the faintness of the light impressed is slightly in favour of the shorter

focus mirror, and that with an exposure of one hour no fainter star than the fifteenth magnitude leaves a trace at all discernible on the photographic film.

In the following tables are given the results of the preceding formulæ as applied to stars whose magnitudes have been determined by the wedge photometer, and recorded in the 'Uranometria Nova Oxoniensis.' In the first column is given the designation of the star in the Pleiades, adopted by Bessel. The remaining columns speak for themselves.

Table I.—Exposure 5 minutes. Mirror $\frac{15}{80}$-inch.

Star's designation.	Measured diameter.	Computed (photographic) magnitude.	Photometric magnitude U.N.O.	Difference C − O in mag.
No. 8......	10″·01	7·27	7·36	−0·09
35......	4·75	9·43	9·67	−0·24
40......	9·89	7·31	7·17	+0·14
22......	11·65	6·70	6·80	−0·10

Table II.—Exposure 30 minutes.

Star's designation.	Measured diameter.	Computed (photographic) magnitude.	Photometric magnitude U.N.O.	Difference C − O in mag.
No. 8......	14″·41	7·44	7·36	+0·08
35......	8·68	9·51	9·67	−0·16
40......	15·11	7·22	7·17	+0·05
22......	16·61	6·77	6·80	−0·03

Table III.—Exposure 60 minutes.

Star's designation.	Measured diameter.	Computed (photographic) magnitude.	Photometric magnitude U.N.O.	Difference C − O in mag.
No. 8......	15″·97	7·33	7·36	−0·03
35......	10·45	9·42	9·67	−0·25
40......	16·64	7·11	7·17	−0·06
22......	17·28	6·91	6·80	+0·11

Attention may here be drawn to the precision of the results obtained by measures so independent of each other. As an accidental result of these recent measures of the photographic magnitude of the stars, it may be mentioned that in May, 1886, the photographic magnitude of Star 22 in the Pleiades was 0·35 magnitude less than the photometric as obtained from very many measures, and I attributed this difference to the probable actinic peculiarity of the star in question, but inasmuch as no such perceptible difference exists in the more recent measures of the photographic and photometric magnitudes, resulting as they do from so many independent determinations, the question of the variability of this star is suggested as very probable. Pleione also in the measures of 1886 exhibits a difference between the photometric and the photographic magnitude. Inasmuch as the same difference in the measures has been again exhibited in the recent measures, it seems reasonable to explain the fact by the peculiar actinic action in the light of this star.

As a further example of the power and applicability of this definite method in reference to faint stars not suitable for determination by the wedge photometer, I may add here the following comparison of the resulting *measures* made by the photographic method, set side by side with the magnitude as *estimated* by Wolf ('Description du Groupe des Pléiades,' Paris, 1874).

Star's designation No. in Wolf.	Measured diameter.	Computed (photographic) magnitude.	Estimated magnitude. Wolf.	Difference C − O in mag.
196	9″·75	9·72	10	−0·28
314	9·98	9·61	10	−0·39
239	6·04	11·51	11	+0·51
241	5·85	11·60	11	+0·60
318	8·15	10·45	11	−0·55
319	8·40	10·34	11	−0·66
325	5·67	11·70	12	−0·30
330	6·14	11·45	12	−0·55
331	5·35	11·87	12	−0·13
320	4·47	12·35	13	−0·65
321	3·98	12·63	13	−0·37
332	4·23	12·49	13	−0·51
302	3·50	12·91	14	−1·09
324	doubtful	..	14	..

It has been more than once proposed to estimate or to measure the photographic magnitudes of stars, by means of the breadth and character of their traces on the photographic plates. This method would involve an unnecessary consumption of time in procuring

impressions made with this object in view alone. But by the method here adopted, the same plates which are taken for ascertaining the co-ordinates of the stars, serve equally well for measuring their photographic magnitudes. It is perhaps unnecessary to point out that practically the photometric and photographic magnitudes are, for the most part, identical. The remark above will fail of application, if it be possible to determine differences of right ascension and of declination from the traces of the stars with sufficient accuracy.

VI. "On the Development of Voltaic Electricity by Atmospheric Oxidation." By C. R. ALDER WRIGHT, D.Sc., F.R.S., Lecturer on Chemistry and Physics, and C. THOMPSON, F.I.C., F.C.S., Demonstrator of Chemistry, in St. Mary's Hospital Medical School. Received April 17, 1888.

In a preliminary note on this subject ('Roy. Soc. Proc.,' vol. 42, p. 212), it has been shown that when copper is immersed in an aqueous solution of ammonia and opposed to an "aëration plate" of some conducting material not otherwise acted upon, lying horizontally on the surface of the fluid, a current flows continuously through a wire, &c., made to connect the two plates, the energy manifested by which is due to the absorption of atmospheric oxygen by the aëration plate and the indirect combination of this with the copper forming cuprous oxide which dissolves in the ammonia. Numerous analogous electromotor cells are readily obtainable by suitably varying the metal susceptible of oxidation and the electrolytic fluid employed, some of which we have submitted to close examination; whilst another class of voltaic cells, acting on much the same principle, we find can be obtained by substituting for the oxidisable metal a platinum or other incorrodible plate immersed in an oxidisable fluid, such as pyrogallol dissolved in caustic soda: preferably the aëration plate is arranged in one vessel on the surface of some convenient fluid (not necessarily identical with the oxidisable one), and the other plate and oxidisable fluid placed in another vessel, the two being connected by a siphon or wet wick; or the whole may be arranged as a gravity battery, the oxidisable fluid being made the heavier one so as to preserve it from direct contact with air; or a U-tube arrangement may be employed. Thus, for example, a platinum plate immersed in an acid solution of ferrous sulphate, or in sulphurous acid solution, connected with a vessel containing dilute sulphuric acid, and an aëration plate of spongy platinum, &c., furnishes an electromotor cell in which the production of a current is accompanied by the virtual transference of oxygen from the aëration plate to the oxidisable fluid, forming

FIG. 1.

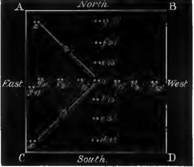


Fig. 2.